NON-NATIVE SPECIES MONITORING AND CONTROL IN THE UPPER SAN JUAN RIVER, NEW MEXICO 2007

FINAL REPORT

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SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

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SUBMITTED TO:
SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM
BIOLOGY COMMITTEE

05 JUNE 2008

EXECUTIVE SUMMARY

1. A total of 10,719 channel catfish and 961 common carp were removed in 312.9 hours of electrofishing from RM's 166.6 – 52.9.

2. Channel catfish CPUE in 2007 from PNM Weir to Hogback Diversion was significantly lower than in 2001 ($p < 0.01$)

3. Channel catfish abundance in from Hogback Diversion to Shiprock Bridge in 2007 was significantly lower than in 2003 ($p = 0.01$).

4. Mean total length (TL) of channel catfish in upper sections of the San Juan River remained similar to lengths observed at the start of removal efforts. However, overall abundance was much reduced.

5. Fewer large (> 500 mm TL) and small (< 300 mm TL) channel catfish comprised the catch in upper sections of the San Juan River compared to early years of removal.

6. Channel catfish abundance remains high downstream of Shiprock Bridge. Few sampling trips make yearly comparisons difficult.

7. Common carp remain uncommon in all collections.

8. Majority of razorback sucker captures occurred ± 10 RM's of stocking location at RM 158.6.

9. Razorback sucker captured four or more times, including 2007 encounters, were collected within seven miles of the stocking location.

10. Twelve Colorado pikeminnow > 400 mm TL collected in 2007 including an age-11 fish.

11. Short term retention of acclimated age-1 Colorado pikeminnow near the stocking location was documented with 7.5% of acclimated fish recaptured from RM 149 – 101.

12. An individual roundtail chub was collected in 2007. First collection during a nonnative removal trip since 2002.

13. Efforts will shift focus to high priority sections (Shiprock Bridge to Mexican Hat) in FY 2008 while maintaining efforts in upstream reaches to ensure current progress is not lost.

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INTRODUCTION

The presence of nonnative fishes within the San Juan River may have deleterious effects on recovery efforts for Colorado pikeminnow (*Ptychocheilus lucius)* and razorback sucker (*Xyrauchen texanus).* The August 1, 2002 *Colorado Pikeminnow and Razorback Sucker Recovery Goals* identified predation or competition by nonnative fishes as a primary threat to the continued existence or the reestablishment of self-sustaining populations of these endangered fish (USFWS 2002a and 2002b). Channel catfish (*Ictalurus punctatus)* and common carp (*Cyprinus carpio*) may affect native aquatic communities through trophic interactions (direct predation, possible competition for food), through spatial interactions (competition for habitat, spawning space or feeding areas), and by habitat alteration (Brooks et al. 2000; Minckley 1991; Sigler 1987; Tyus and Saunders 2000). Of these factors, direct predation and aggressive behavior/harassment is documented for the San Juan River (Brooks et al. 2000 and Ryden 2005).

Recognized goals of nonnative fish management as stated in the San Juan River Recovery Implementation Program's (SJRIP) Final Program Document (2006) include: "1.) nonnative fish management will occur to attain and maintain fish communities where populations of the endangered and other native fish species can persist and thrive, and the recovery goals for the endangered fishes can be achieved, and 2.) management of nonnative fishes will be conducted as needed. Implementation of an effective nonnative fish management program is an adaptive process. As strategies are developed and implemented, they will be evaluated and revised based on results of research and monitoring". Nonnative fish monitoring and control in the upper San Juan River has operated under this guidance since its inception in 2001.

Removal efforts by U.S. Fish and Wildlife Service, New Mexico Fish and Wildlife Conservation Office (NMFWCO) began on a limited basis in 1998 with intensified efforts beginning in 2001. Efforts focused on a 7.6 mile reach located near Fruitland, NM. Location of concentrated removal efforts was influenced by information on adult fish distribution and abundance reported by Ryden (2000). Numbers of channel catfish and common carp appeared to be lower upstream of PNM Weir (RM 166.6) and the majority of nonnative fishes within Geomorphic Reaches 6 and 5, as described by Bliesner and Lamarra (2000), were considered adult. The presence of water diversion structures that may serve as potential impediments to upstream fish movement and the propensity of large adult nonnative fishes determined where intensive removal efforts would focus.

Efforts in 2007 marked the seventh consecutive year of removal from PNM Weir to Hogback Diversion (RM 166.6 - 159.0). Due to observed seasonal variance in catch rates (CPUE; fish/hour of electrofishing), it was assumed that fish were immigrating from downstream reaches during summer months. Mark/recapture work conducted by NMFWCO confirmed this movement prompting an expansion of efforts in 2003 to include an additional 11.1 river miles immediately downsteam of Hogback Diversion (Davis and Coleman 2004). These movement patterns corresponded with the completion of the non-selective Hogback fish ladder in 2001 at RM 159.0.

Due to increased channel catfish abundance in portions of the San Juan River that lacked intensive removal efforts, efforts were expanded in 2006 to include intensive removal passes from Shiprock Bridge to Mexican Hat, Utah (22 February 2005 SJRIP Biology Committee meeting). A total of three trips were conducted in this section in 2007. In addition to intensive non-native removal trips, opportunistic removal riverwide

continued during sub-adult and adult fish monitoring trips in 2007. Removal of non-native fish during these trips has occurred, to some degree, since 1996.

Study objectives were:

1. Continue data collection and mechanical removal of large bodied non-native fish during main channel and rare fish monitoring efforts.

2. Evaluate distribution and abundance patterns of non-native species to determine effects of mechanical removal.

3. Characterize distribution and abundance of endangered fish in the upper reaches of the San Juan River

4. Expand intensive removal efforts downstream to Montezuma Creek, Utah (RM 93.6) while still maintaining sufficient effort to maintain current accomplishments within upstream sub-reaches.

5. Continue and expand transplantation of channel catfish to closed impoundments isolated from the San Juan River with the assistance of New Mexico Department of Game and Fish, Navajo Nation Fish and Wildlife Service and the Southwest Tribal Fish Commission (SWTFC).

STUDY AREA

Intensive nonnative removal efforts in 2007 focused on three individual sections of the San Juan River, New Mexico, Colorado, Utah, encompassing 113.7 river miles (RM). Sections included PNM Weir to Hogback Diversion (RM 166.6 – 159.0), Hogback Diversion to Shiprock Bridge (RM 158.8 – 147.9), and Shiprock Bridge to Montezuma Creek, Utah (RM 147.9 – 93.1) (Figure 1). One removal trip was conducted in 2007 from Montezuma Creek to Mexican Hat, Utah (RM 93.1 – 52.9). Nonnative removal was conducted in portions of Geomorphic reaches 6 – 2 as defined by Bliesner and Lamarra (2000). PNM Weir to Hogback Diversion is exclusively located in Geomorphic Reach 6, Hogback Diversion to Shiprock Bridge encompasses portions of both Geomorphic reaches 6 and 5, and Shiprock Bridge to Mexican Hat lies in reaches 5 – 2.

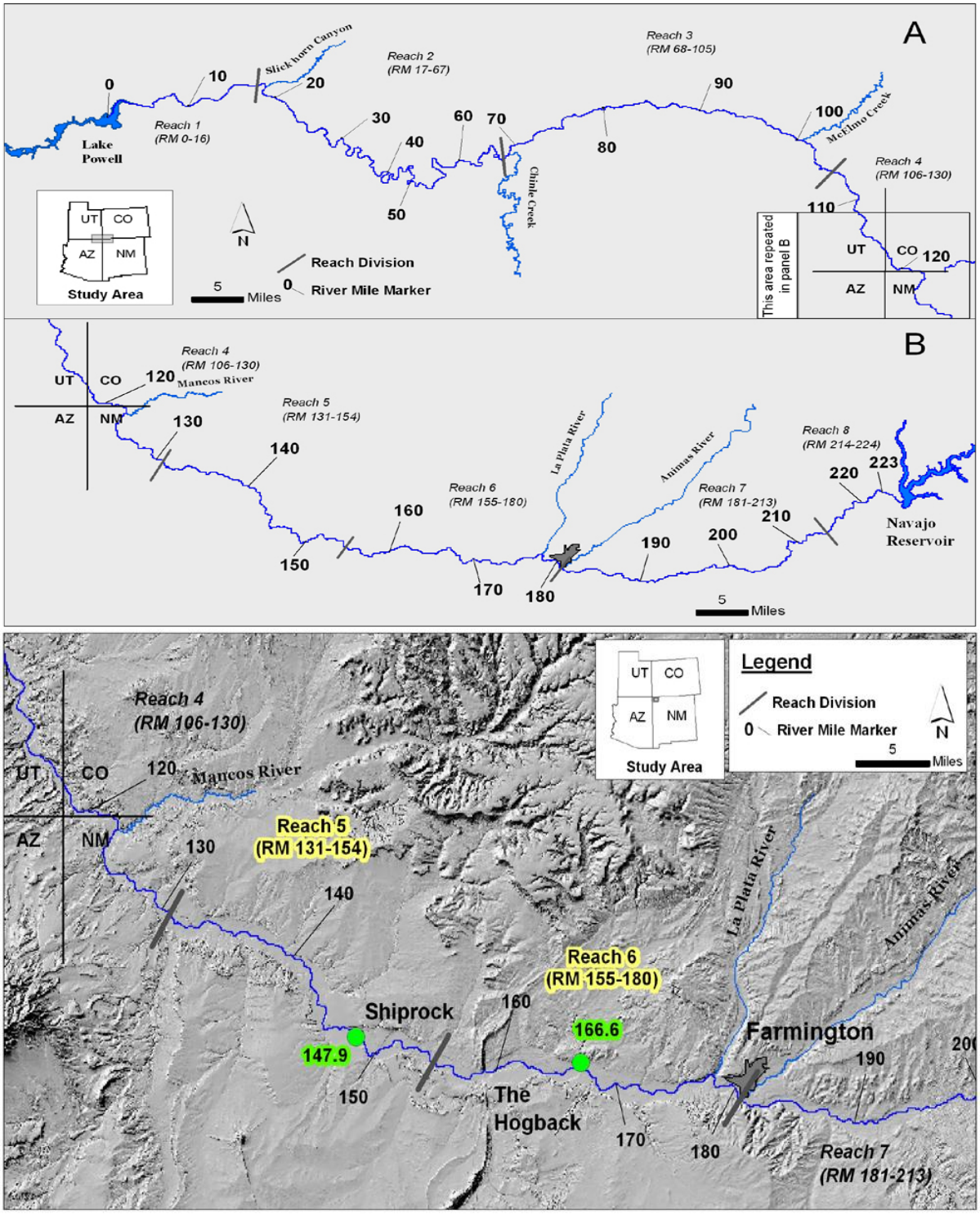

Figure 1. Map of study area including entire San Juan River basin (top) and a more detailed map of intensive removal reaches (green highlights; bottom). –map provided by UNM MSB

METHODS

Nonnative fishes were collected using raft-mounted electrofishing units. Rafts consisting of a rower and one netter floated near each shoreline netting all nonnative fishes observed. In addition to nonnative species, rare fishes were netted during all efforts. A support raft was used to collect any non-native fishes that surfaced behind the electrofishing raft and were included in the calculation of CPUE. All nonnative fishes or a representative sub-sample (blind grab) were measured (nearest 1 mm) for total and standard lengths and weighed (nearest 5 g) for mass. Seconds of electrofishing were recorded to determine effort. All nonnative fishes were removed from the river. When possible, channel catfish were held for transplantation. Channel catfish were kept in live wells treated with salt and stress coat to alleviate stress caused by holding and transporting. A battery powered aeration system or compressed oxygen was used for circulation and aeration. Channel catfish were transported from the San Juan River in distribution trucks provided by the Navajo Nation Department of Fish and Wildlife.

All available capture data were analyzed independently by Section. For example, catch rates among years from PNM to Hogback, Hogback to Shiprock and Shiprock to Montezuma Creek were compared only with the same Section and not across sections. To determine trends in distribution and abundance, mean catch rates (fish per hour of electrofishing; CPUE) and standard errors (± 1 SE) were calculated using the software package SPSS version 13.0 (2004). Species CPUE is the total number of fish collected divided by the total effort of sampling (hours of electrofishing). Data were summarized by Section, trip, and year. If CPUE data met the assumptions of normality and equality of variance, a One Way Analysis of Variance (ANOVA) was conducted to determine if significant differences existed. Multi pairwise comparisons using Bonferroni post hoc tests

were used to determine where specific differences existed. If data were heteroscedastic, and transformations were unsuccessful in attaining equal variance, an ANOVA on ranked data (Kruskal-Wallis) was conducted with Nemenyi post hoc tests to determine where specific differences existed (Zar 1996).

RESULTS

PNM WEIR TO HOGBACK DIVERSION (RM 166.6 – 159.0)

A total of 351 channel catfish and 141 common carp were collected during four trips (March to November) and 63.6 hours of electrofishing (Appendix A-1**)**. In addition to channel catfish and common carp, other non-native fishes removed from this Section included rainbow trout (*Oncorhynchus mykiss)*, brown trout (*Salmo trutta)*, bullhead catfishes (*Ameiurus spp).*, largemouth bass (*Micropterus salmoides)*, green sunfish (*Lepomis cyanellus)*, and white sucker (*Catostomus commersoni)* . No striped bass (*Morone saxatilis)* or walleye (*Sander vitreus)* were collected or observed.

CHANNEL CATFISH

Channel catfish CPUE was < 1.0 fish/hour during the March and April trips. Catch rates increased for the July trip to 10.6 fish/hour and remained similar for the November trip (9.6 fish/hour), primarily reflecting abundance of adults in the catch (Figure 2). Channel catfish CPUE for all trips and all life stages combined was 5.2 fish/hour (Figure 3).

Channel catfish CPUE in 2007 was significantly lower than CPUE in 2001 and 2004 (ANOVA; $F = 4.684_{(6, 392)}$; Nemenyi post-hoc, $p < 0.01$, $p < 0.01$; respectively). Catch rates for all life stages combined were at the lowest level (5.2 fish/hour) observed among 2001-2007 comparisons (Figure 3). Juvenile CPUE was similar to that in 2006 but adult

channel catfish CPUE was significantly lower than adult CPUE in 2001 and 2004 (ANOVA; $F = 4{,}560_{(6, 392)}$; Nemenyi post-hoc, $p < 0.01$ and $p < 0.01$) (Figure 3).

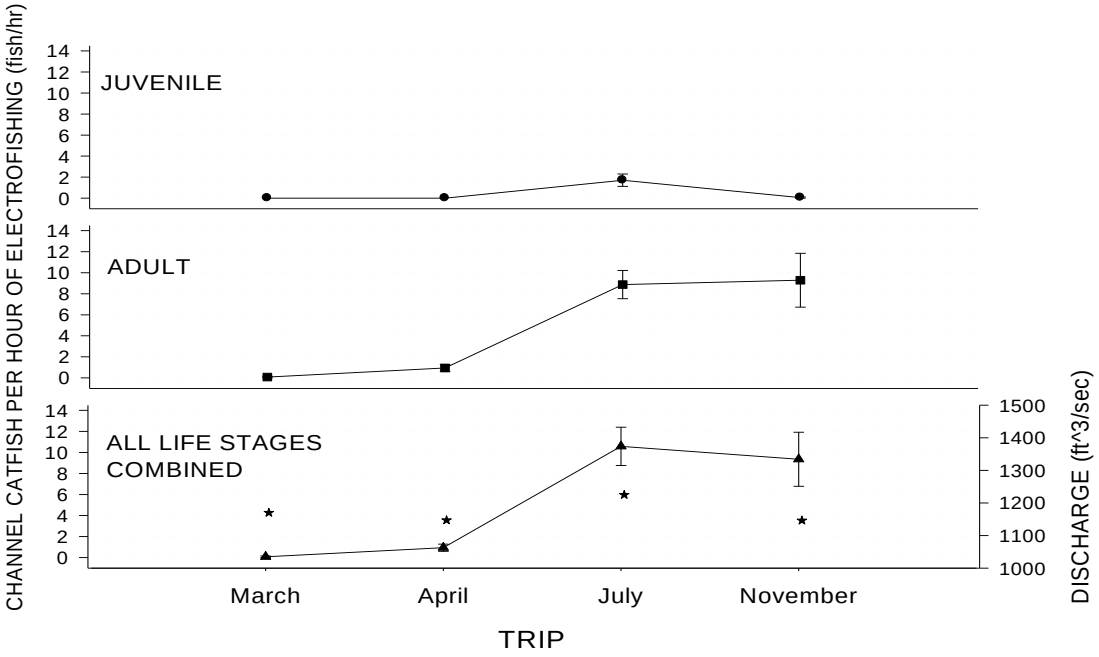

Figure 2. Channel catfish CPUE (fish/hour) by trip within the PNM Weir to Hogback Diversion Section; 2007. Error bars represent ± 1 SE. Stars represent mean discharge for the trip recorded at USGS gauge #0936800 near Shiprock, New Mexico.

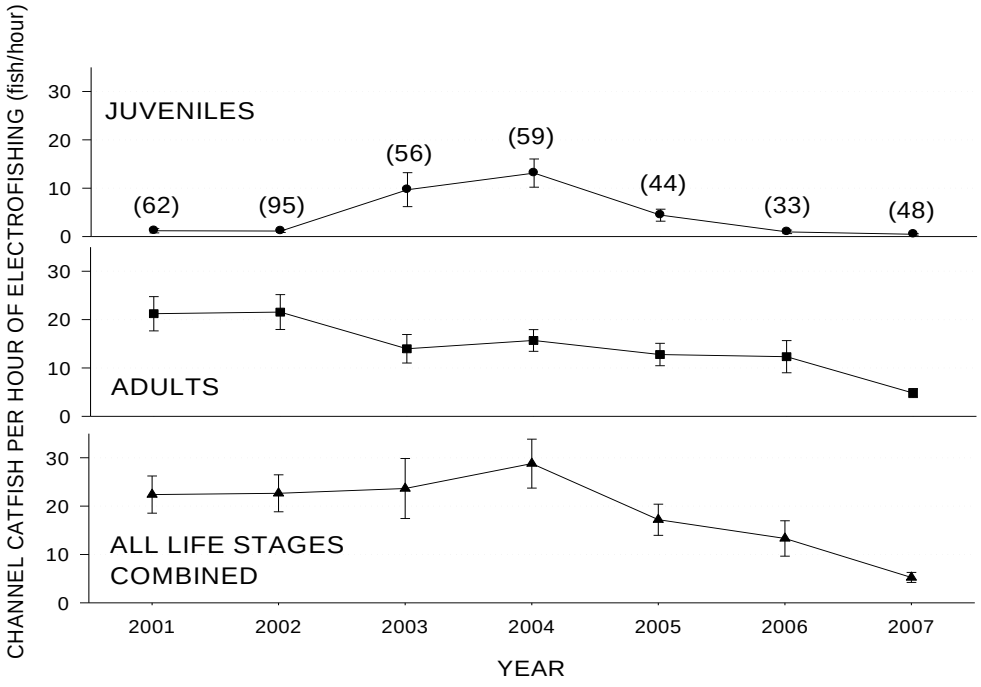

Figure 3. Channel catfish CPUE (fish/hour) by year within the PNM Weir to Hogback Diversion Section; 2007. Total sample size listed parenthetically and error bars represent ± 1 SE.

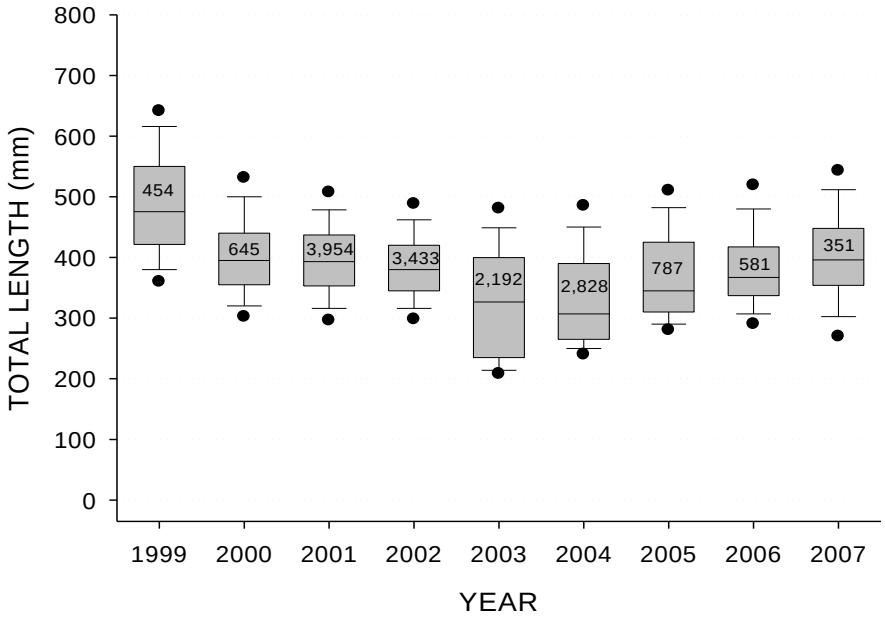

Figure 4. Size class distribution of channel catfish collected from PNM Weir to Hogback Diversion, 1999 – 2007. Line in the box represents the median and bars represent 25th and 75th percentiles. Dots represent 5th and 95th percentiles. Sample size listed in box.

Table 1. Percentage of channel catfish by size class collected from PNM Weir to Hogback Diversion, 1999-2007. Intensive nonnative removal began in 2001.

	≤ 300 mm	301-400 mm	401-500 mm	501-600 mm	> 600 mm
1999	0	18.8	28.6	39.6	13
2000	4.3	48.1	37.8	7.5	2.3
2001	6.0	49.5	38.5	5.3	0.7
2002	5.7	63.4	28.7	2.1	0.1
2003	42.7	33.4	20.7	3.1	0.1
2004	47.7	30.7	18.2	3.3	0.2
2005	18.6	50.5	24.8	6.0	0.1
2006	8.3	60.9	23.7	6.1	1.0
2007	9.4	43.9	34.4	11.7	0.6

Inspection of percentiles around median length indicate channel catfish TL has changed little since 1999 (Figure 4). In most years including 2007, the majority of the catch ranged from 250 to 450 mm TL. Fewer large channel catfish were collected with fish > 400 mm TL comprising 46.7% of the fish collected in 2007 compared to 81.2% in 1999 (Table 1). Channel catfish, > 500 mm TL comprised 52.6% of the catch in 1999 compared

to 12.3% in 2007. Two individual catfish > 600 mm were collected in 2007. Juvenile fish (≤300 mm TL) abundance was similar to 2006 but juveniles remained uncommon in collections (9.4% of total catch).

COMMON CARP

Common carp CPUE varied little among 2007 trips and was below 5.0 fish/hour for each of the four trips (Figure 5). The highest values for CPUE occurred in March and varied between 1 and 2 fish/hour on the other trips. The four trip mean CPUE was 2.2 fish/hour (Figure 6).

Comparison of common carp CPUE among years showed significant declines since 2001 resulting in the lowest observed CPUE since intensive nonnative removal began (ANOVA; $F=24.461_{(6, 392)}$; Nemenyi post-hoc, $p < 0.01$). Common carp CPUE in 2007 was similar to values observed in 2006 but was significantly lower than all previous years (Figure 6). Since 2004, annual common carp CPUE has been < 5.0 fish/hour. Common carp were considered uncommon in collections conducted from PNM Weir to Hogback Diversion.

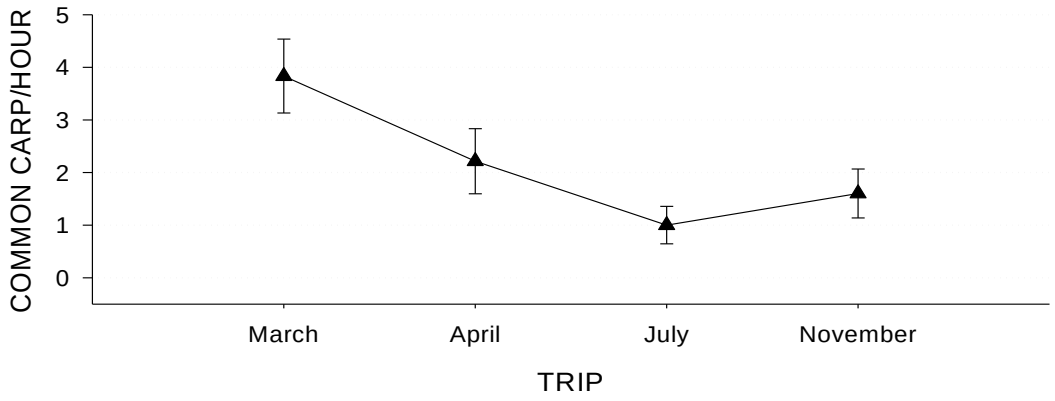

Figure 5. Common carp CPUE (fish/hour) by trip within the PNM Weir to Hogback Diversion Section; 2007. Error bars represent ± 1 SE.

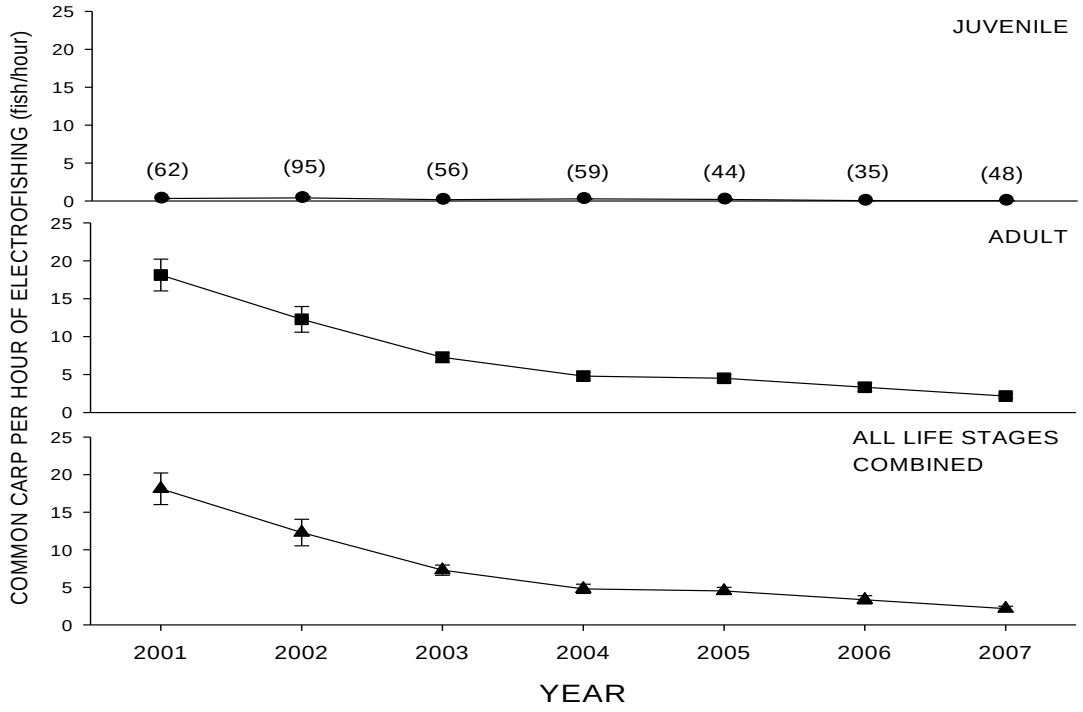

Figure 6. Common carp CPUE (fish/hour) by year within the PNM Weir to Hogback Diversion Section; 2007. Total sample size listed parenthetically and error bars represent ± 1 SE.

HOGBACK DIVERSION TO SHIPROCK BRIDGE (RM 158.8 – 147.9)

A total of 1,154 channel catfish and 142 common carp were collected during four trips (March to November) and 70.4 hours of electrofishing (Appendix A-2). In addition to channel catfish and common carp, other non-native fishes removed included, brown trout, bullhead catfishes, and white sucker. No striped bass or walleye were collected or observed.

CHANNEL CATFISH

Channel catfish CPUE varied by trip and ranged from 1.9 to 38.4 fish/hour (Figure 7). Flows exceeding 4,000 ft^3/sec during the May and August trips affected our ability to capture channel catfish. Utilizing CPUE from these trips significantly reduced the annual mean CPUE (e.g. 12.7 fish/hour including May and August compared to 20.5 fish/hour excluding trips) and were therefore excluded in mean CPUE calculations for the year.

Channel catfish CPUE was 5.1 fish/hour during the March 2007 trip representing one of the lowest CPUE observed for channel catfish in this Section during the study period. The highest CPUE (38.4 fish/hour) in 2007 was during the November trip. This seasonal increase was typical of past years but at a much lower magnitude. For example, the highest channel catfish CPUE in 2004 peaked at 98.0 fish/hour compared to 38.4 fish/hour in 2007.

Channel catfish CPUE declined significantly from 57.7 to 20.5 fish/hour from 2003 to 2007 (ANOVA; $F = 37.61_{(4, 588)}$; Nemenyi post-hoc, $p = 0.01$) (Figure 8). Channel catfish CPUE in 2007 remained below 30.0 fish/hour for the third consecutive year. Juvenile and adult CPUE was similar to CPUE in 2005 and 2006.

Inspection of percentiles around median TL of channel catfish indicates no detectable change in length since intensive removal began (Figure 9). Mean TL did increase slightly for the third consecutive year, 409.5 mm, but additional sampling is needed to verify any pattern of directionality in length. Fish ≥ 400 mm TL comprised 49.1% of the total catch in 2003 compared to 51.8% in 2007 (Table 2). Fish ≥501 mm TL increased in abundance in 2007 comprising 15.0% of the catch (Figure 9). Twelve individual catfish > 600 mm were collected in 2007.

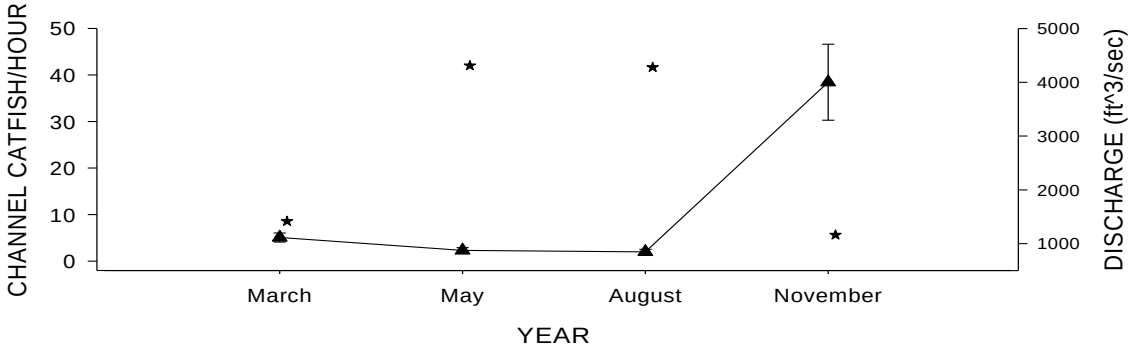

Figure 7. Channel catfish CPUE (fish/hour) by trip within the Hogback Diversion to Shiprock Bridge Section, 2007. Error bars represent ± 1 SE. Stars represent mean discharge for each trip recorded at USGS gauge #0936800 near Shiprock, New Mexico.

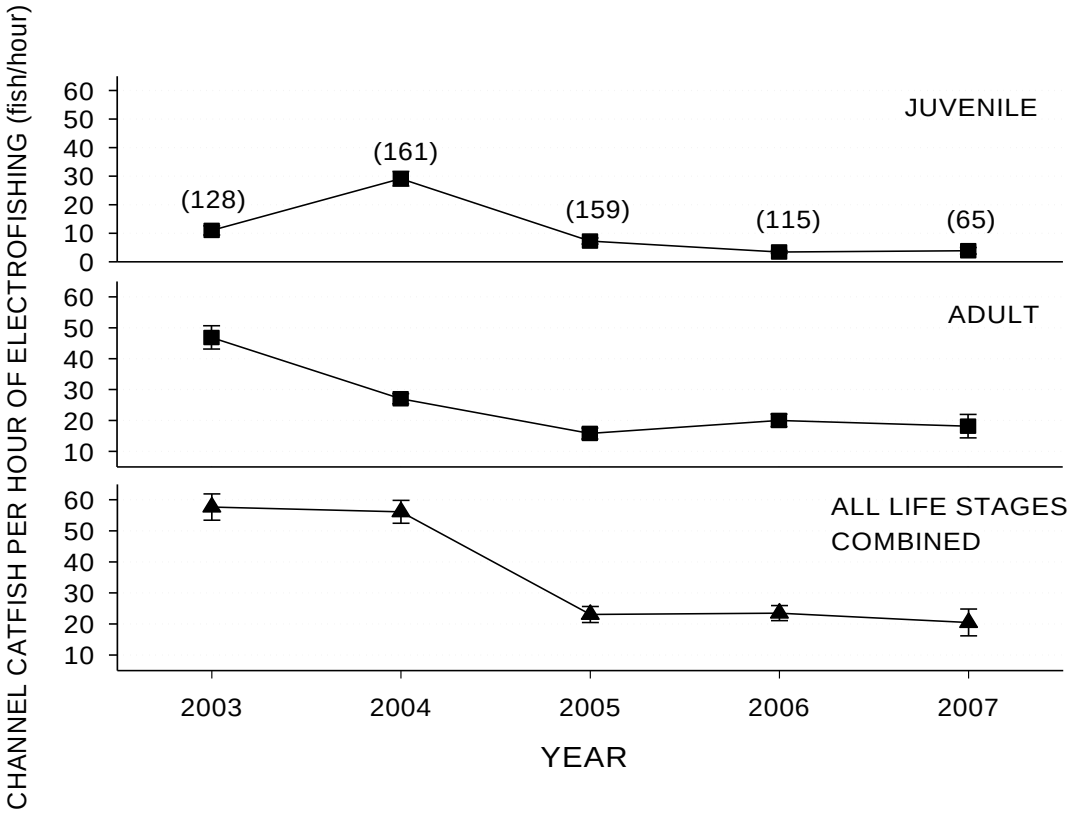

Figure 8. Channel catfish CPUE (fish/hour) by year within the Hogback Diversion to Shiprock Bridge Section, 2003-2007. Sample size listed parenthetically and error bars represent ± 1 SE. Mean catch rate in 2007 exclude data from trips conducted during flows> 4,000 ft^3/sec (May and August 2007).

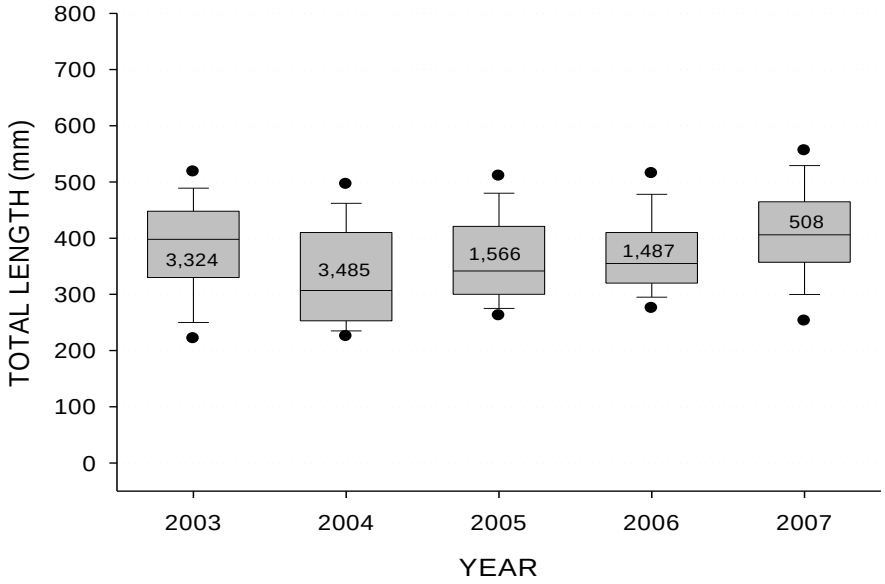

Figure 9. Size class distribution of channel catfish collected from Hogback Diversion to Shiprock Bridge, 2003 – 2007. Line in the box represents the median and bars represent 25th and 75th percentiles Dots represent 5th and 95th percentiles. Sample size listed in box.

Table 2. Percentage of channel catfish by size class collected from Hogback Diversion to Shiprock Bridge, 2003-2007. Intensive nonnative removal began in 2003.

	≤ 300 mm	301-400 mm	401-500 mm	501-600 mm	≥ 600 mm
2003	19.0	31.9	40.6	7.0	1.5
2004	48.3	24.5	22.9	4.0	0.3
2005	26.5	42.1	23.8	6.1	1.5
2006	12.4	57.5	21.0	6.3	2.8
2007	10.4	37.8	36.8	12.6	2.4

COMMON CARP

Common carp CPUE in 2007 varied little among trips averaging 2.0 fish/hour for 2007 (range 0.5-2.7 fish/hour). For the third consecutive year no individual trip exceeded 10 fish/hour (Figure 10). The majority of common carp collections consisted of adult fish with juveniles (< 250 mm TL) comprising less than 1.0% of the total catch (0.1 fish/hour).

Common carp CPUE in 2007 was significantly lower than in all previous years (Figure 11). Mean CPUE values in 2003, the initiation of intensive removal, were higher (29.4 fish/hour) compared to values in 2007 (2.7 fish/hour; ANOVA; $F = 162.355_{(4, 671)}$; Nemenyi post-hoc, $p < 0.01$).

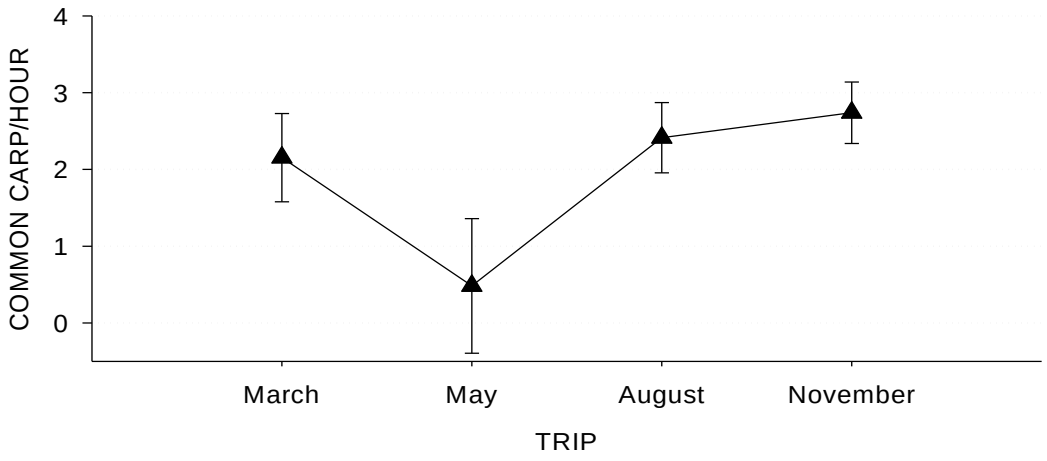

Figure 10. Common carp CPUE (fish/hour) by trip within the Hogback Diversion to Shiprock Bridge Section; 2007. Error bars represent ± 1 SE.

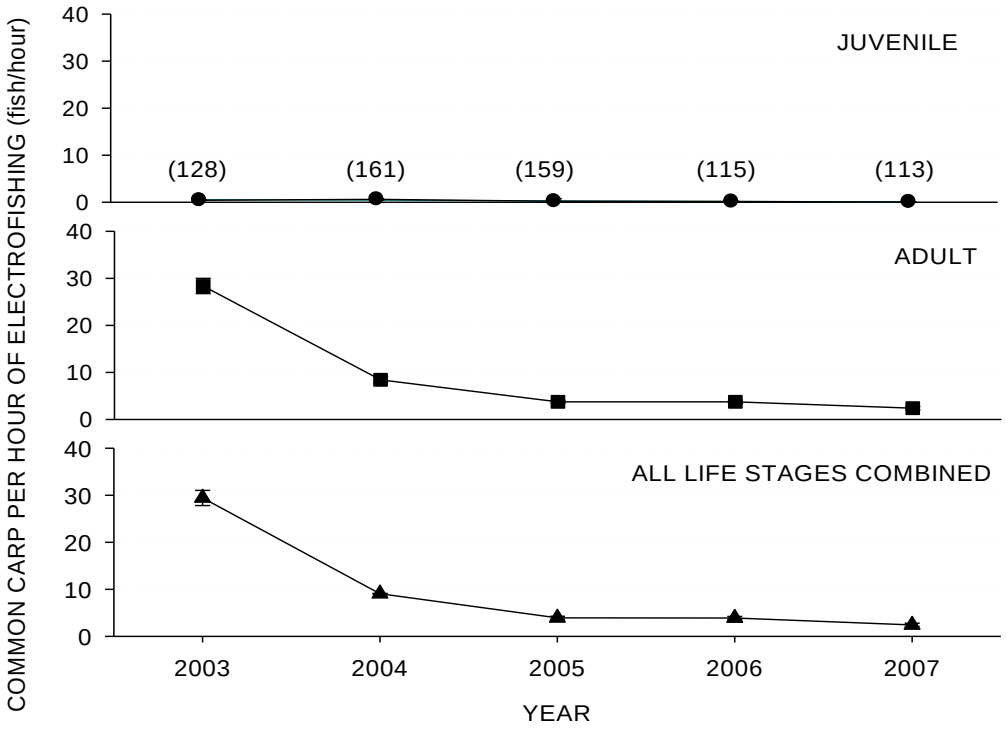

Figure 11. Common carp CPUE (fish/hour) by year within the Hogback Diversion to Shiprock Bridge Section. Sample size listed parenthetically and error bars represent ± 1 SE.

SHIPROCK BRIDGE TO MEXICAN HAT, UTAH (RM 147.9 -52.9)

Three removal trips (May, July and August) were conducted from Shiprock Bridge to Montezuma Creek, Utah yielding 7,961 channel catfish and 584 common carp in 141.3 hours of electrofishing (Appendix A-3). One additional trip was conducted in July from Montezuma Creek to Mexican Hat yielding 1,253 channel catfish and 94 common carp in 37.6 hours of electrofishing. In addition to channel catfish and common carp, other non-native fishes removed included bullhead catfishes, and bluegill. No striped bass or walleye were collected or observed.

CHANNEL CATFISH

Mean CPUE from Shiprock Bridge to Montezuma Creek ranged from 40.1 to 80.0 fish/hour of electrofishing (Figure 12). Catch rates during July were significantly higher

than all other trips in 2007 (ANOVA; $F = 25.728_{(2, 113)}$; Nemenyi post-hoc, $p \leq 0.001$) with juvenile and adult CPUE higher during July than all other trips. Catch rates were similar between June and August trips although flows were markedly different (Figure 12). These data suggest that channel catfish abundance was high enough to reduce effects high flows may have had on channel catfish catch.

Catch rates for all life stages combined was similar among Geomorphic reaches (Figure 13). Adult channel catfish were more abundant in Geomorphic Reach 5 than in Geomorphic Reach 3 (ANOVA; $F = 5.764_{(2, 113)}$; Nemenyi post-hoc; $p < 0.01$) and juvenile fish were more abundant in downstream reaches (ANOVA; $F = 17.812_{(2, 113)}$; Nemenyi post-hoc; $p < 0.01$).

Mean channel catfish CPUE from Montezuma Creek to Mexican Hat in 2007 was 32.7 fish/hour of electrofishing and was lower than 2006, 61.5 fish/hour (t-test; $t = 4.070$; $p < 0.001$). Juvenile channel catfish CPUE in 2007 was generally higher than adult CPUE throughout this Section (Figure 14).

Channel catfish mean TL in 2007 was similar to values observed in 2006. Fish collected from Shiprock Bridge to Mexican Hat averaged 338 mm (range 32 – 703 mm) in 2007 compared to 347 mm (range 29 – 802 mm) in 2006. Mean TL in 2007 decreased as sampling progressed downstream with a mean TL of 345 mm from Shiprock Bridge to Montezuma Creek and a mean TL of 300 mm downstream of Montezuma Creek (t-test; $t = 9.482$, $p < 0.01$)

COMMON CARP

Common carp abundance from Shiprock Bridge to Mexican Hat was low in 2007 with a mean CPUE of 3.8 fish/hour of electrofishing. Common carp CPUE was similar to CPUE in 2006, 5.8 fish/hour, and common carp were rare in collections. Highest CPUE

was in Geomorphic Reach 5 (5.7 fish/hour) and decreased downstream (0.8 fish/hour in Geomorphic Reach 2).

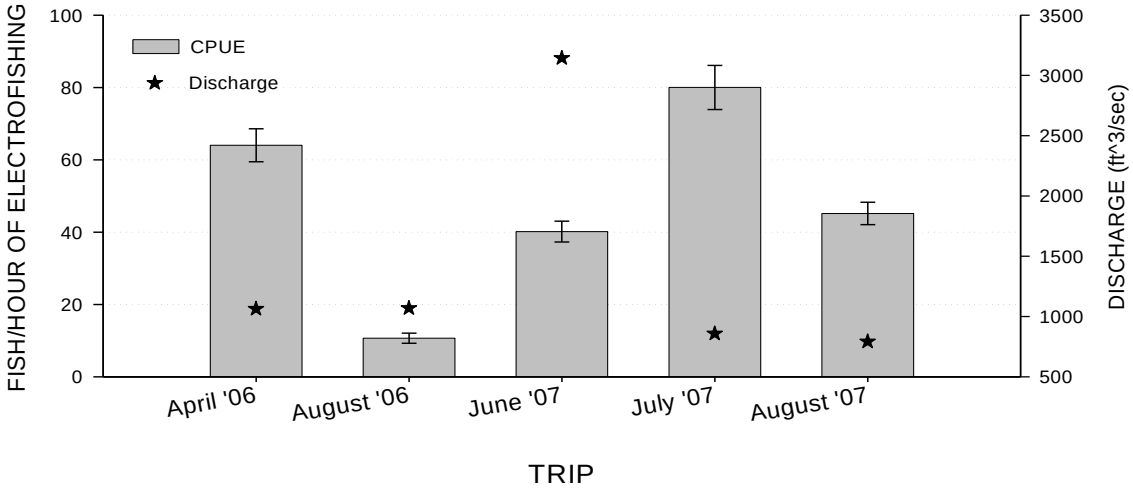

Figure 12. Channel catfish CPUE (fish/hour of electrofishing) collected during intensive non-native removal trips from Shiprock Bridge to Montezuma Creek, Utah; 2006. Error bars represent ± 1 SE. Stars represent mean discharge for the trip recorded at USGS #09379500 near Bluff, Utah.

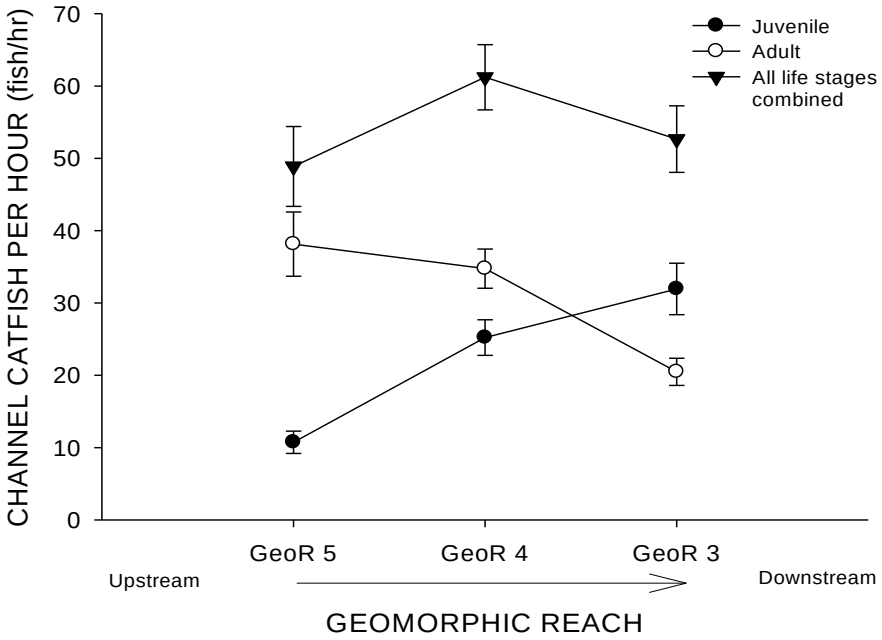

Figure 13. Channel catfish CPUE (fish/hour of electrofishing) by Geomorphic Reach and size class, Shiprock Bridge to Montezuma Creek; 2007. Error bars represent ± 1 SE.

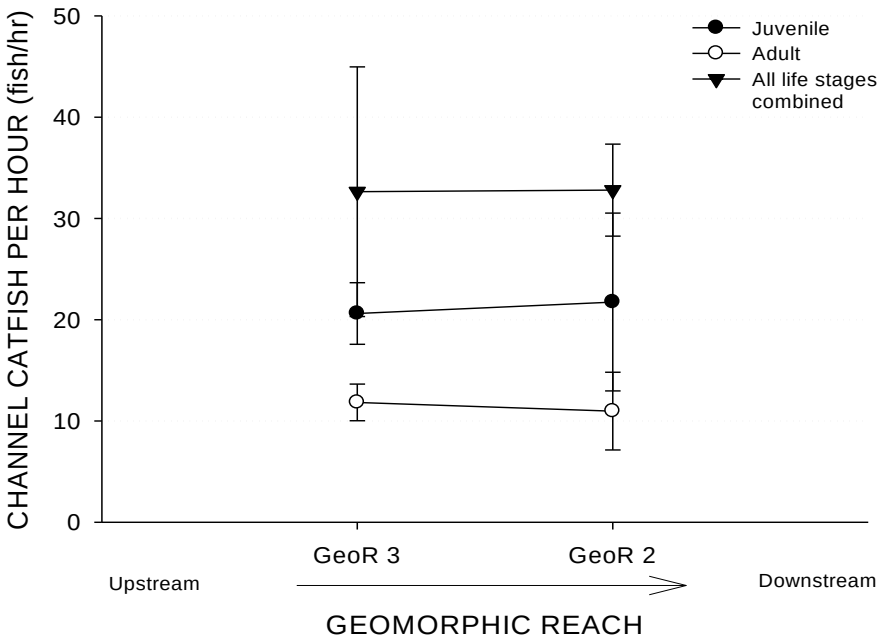

Figure 14. Channel catfish CPUE (fish/hour of electrofishing) by Geomorphic Reach and size class, Montezuma Creek to Mexican Hat; 2007. Error bars represent ± 1 SE

RARE FISH CAPTURES

A total of 881 razorback sucker and 624 Colorado pikeminnow encounters were documented during nonnative fish removal trips from PNM Weir (RM 166.6) to Mexican Hat, Utah (RM 52.9). Fish that were captured multiple times during an individual trip were included, but fish captured multiple times on the same day were excluded from the total number of encounters. Of these fish, 51 razorback and 57 Colorado pikeminnow were collected from PNM to Hogback Diversion; 482 razorback sucker and 210 Colorado pikeminnow were collected from Hogback Diversion to Shiprock Bridge; and 348 razorback sucker and 357 Colorado pikeminnow were collected from Shiprock Bridge to Mexican Hat (Appendix A-3). An individual roundtail chub (*Gila robusta)* was collected in

the PNM Weir to Hogback Diversion section. This fish represented the first capture during intensive nonnative removal since 2002.

RAZORBACK SUCKER

All razorback sucker collected in 2007 were considered to be stocked fish. Although fish were recaptured lacking PIT tags it was assumed these fish were Navajo Agricultural Products Industry (NAPI) pond fish stocked without tags (Ryden 2008). The majority of recaptures were classified as unknown age classes and were most likely NAPI pond fish stocked without PIT tags. Various known age classes were recaptured dating back to 1997 with unknown and 2006 age classes comprising the majority of recaptures (Table 3). Razorback sucker ≤ 300 mm TL were collected on average 47 days (range; 4 – 345 days) post-stocking and fish > 500 mm TL were encountered on average 589 days post-stocking (Table 4). All razorback sucker encounters with known stocking histories occurred on an average of 393 days (range 4 to 3,196 days) post-stocking.

Fish were captured throughout the study area and exhibited both downstream movement to Mexican Hat and movement upstream of both the stocking location (RM 158.6) and Hogback Diversion (Figure 15). The highest number of encounters and CPUE for razorback sucker were from RM 158.8 – 151 (Figure 15). A total of 170 razorback sucker were encountered < 50 days post-stocking and were primarily recaptured within ± 10 RM's of the stocking location. Fish were collected throughout the study area ranging from upstream of Hogback Diversion (RM 159.0) downstream to RM 53.0. A total of 33 fish were encountered < 10 days post-stocking and were recaptured from RM's 153.0 – 107.0 (Figure 16). Two separate groups of encounters near the stocking location were documented 2.5 – 3.5 years and 5.0 – 6.0 years post-stocking (Figure 16).

A total of 10 razorback sucker were captured that had been encountered by NMFWCO four or more times, including 2007 encounters. All fish were recaptured within seven miles of the stocking location at each encounter and ranged up to three years between encounters (Table 5).

Table 3. Summary of razorback sucker by age class collected during nonnative fish removal efforts, NMFWCO; 2007.

Age Class	N	Mean TL (range)
Unknown	358	384 (184 – 580)
1997	1	515
1999	22	470 (430 – 539)
2000	22	473 (430 – 558)
2001	78	459 (367 – 509)
2002	28	441 (388 – 492)
2003	71	470 (395 – 551)
2004	51	326 (258 - 459)
2005	71	257 (168 - 361)
2006	185	388 (245 – 585)

Table 4. Average number of days post-stocking, by size class, that razorback sucker were collected during nonnative removal trips conducted by NMFWCO; 2007. Fish captured at RM 159 were collected between RM 163.7 and 158.8 (Hogback Diversion).

Size	N	Ave. number of days of post stocking (range)	Rive Mile (range)
100-300 mm	174	47 (4 to 345)	159-53
301-400 mm	225	109 (6 to 2,433)	159-53
401-500 mm	434	649 (8 to 2,547)	159-53
500 + mm	45	589 (13 to 3,196)	159-69
Totals	**878**	**393 (4 to 3,196)**	

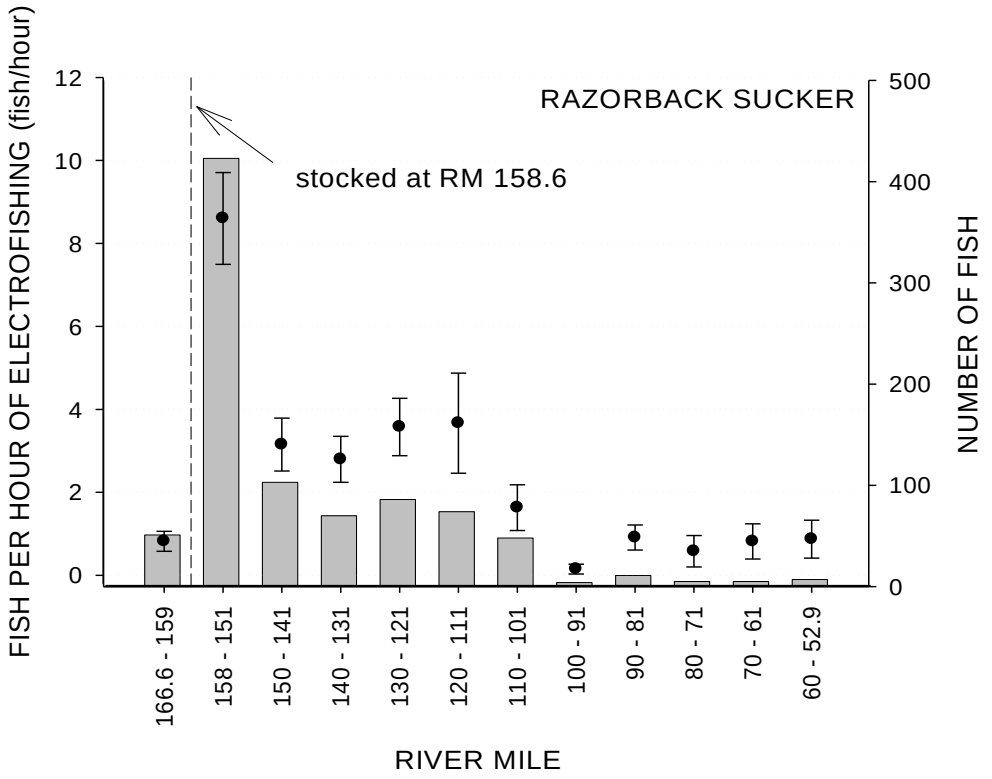

Figure 15. Longitudinal distribution of razorback sucker encounters during nonnative fish removal trips conducted by NMFWCO; 2007. Error bars represent ± 1 SE.

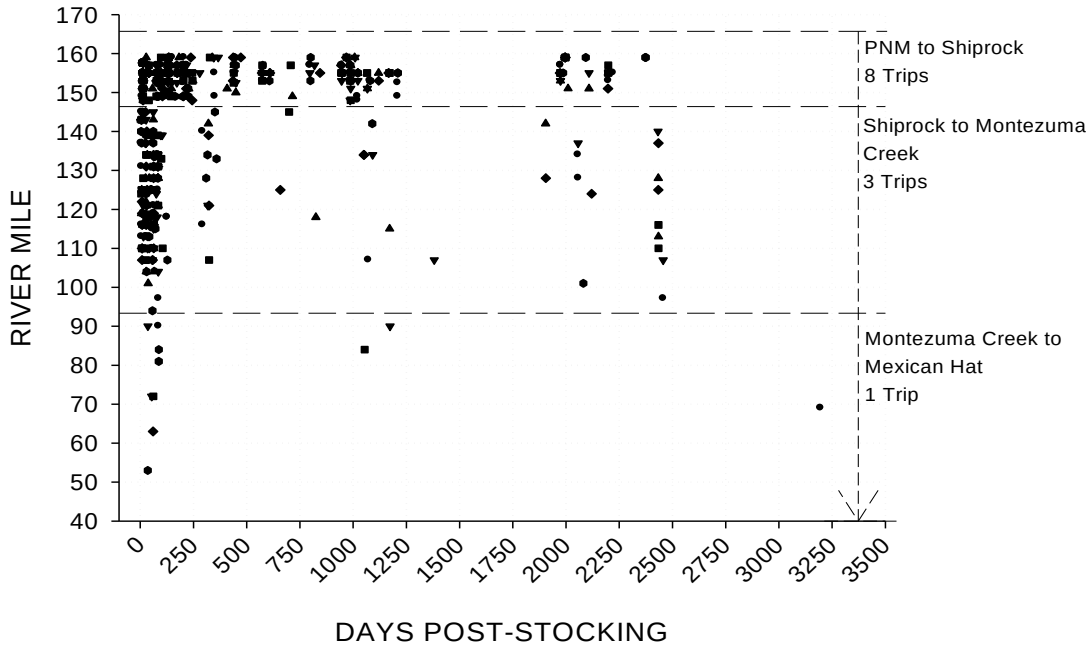

Figure 16. Days post-stocking verses river mile for razorback sucker encounters during nonnative fish removal trips conducted by NMFWCO; 2007.

Table 5. Stocking and recapture history of razorback sucker captured four or more times including 2007 collections. (* indicates a fish that was collected upstream of Hogback Diversion; ** represents difference in length/mass measurements from previous collection likely a result of different individuals taking measurements).

PIT tag	Stocking Date	Stocking Location	Length/Mass @ Stocking (mm/grams)	Recapture Date	Recapture RM	Recapture Length/Mass (mm/grams)
3D9257C693548	30 Oct 2001	158.6	451 / no mass	07 May 2003 04 Jun 2004 19 Apr 2007 06 Nov 2007	155.4 156.9 159* 157	460 / 1200 460 / 1040 478 / 1150 480 / 1250
3D9257C69A6B4	30 Oct 2001	158.6	445 / no mass	14 May 2003 11 Nov 2003 18 Nov 2004 08 Aug 2007 07 Nov 2007	154.9 157 154 155 155	462 / 1250 462 / 1250 465 / 1320 480 / 1190 473 / 1050**
3D91BF1D8B411	01 Nov 2001	158.6	390 / no mass	07 Apr 2004 13 May 2004 21 Apr 2005 28 Mar 2007	155 152 151 153	450 / 770 450 / 820 461 / 970 475 / 1000
3D91BF18D0DF6	14 Jul 2004	158.6	417 / no mass	31 Aug 2004 19 Apr 2005 08 Nov 2005 06 Nov 2007	157.8 155.7 155 155	417 / 750 422 / 740 450 / 1100 502 / 1320
3D91BF18D17CA	14 Jul 2004	158.6	422 / no mass	28 Jul 2005 12 Apr 2006 27 Mar 2007 29 Mar 2007	152.5 155 153 153	435 / 740 442 / 841 454 / 790 447 / 810**
3D91BF18D227A	14 Jul 2004	158.6	419 / no mass	28 Jul 2005 15 Sep 2005 07 Nov 2006 28 Mar 2007	155 155 155 153	450 / 810 452 / 990 489 / 1500 480 / 1300**
3D91BF1CD5B68	26 Aug 2004	158.6	420 / no mass	17 Nov 2004 20 Apr 2005 28 Mar 2007 29 Mar 2007 06 Nov 2007	156 157 157 155 155	420 / 705 420 / 700 466 / 1020 465 / 1000** 491 / 1050
3D91BF1E8ED19	13 Jul 2004	158.6	386 / no mass	21 Apr 2005 29 Jun 2005 07 Nov 2006 28 Mar 2007 29 Mar 2007 01 May 2007	155 152.5 155 157 155 155	399 / 570 401 / 540 424 / 850 434 / 840 436 / 856 435 / 841**
3D91BF1CD2BBE	31 Aug 2005	158.6	398 / 545	27 Jun 2006 14 Sep 2006 09 Nov 2006 06 Nov 2007	155 155 157 157	397 / 530 437 / 790 425 / 810** 450 / 950
3D9257C6B2DCB	22 Aug 2006	158.6	480 / no mass	12 Sep 2006 14 Sep 2006 08 Nov 2006 28 Mar 2007 08 Nov 2007	157 157 157 155 159*	466 / 790** 480 / 750 480 / 895 488 /880 492 / 1300

Razorback sucker collected in 2007 ranged in size from 168 – 585 mm TL (Figure 17). The majority of fish captured (n = 710) were > 300 mm TL with 483 captures > 400 mm TL. Of fish > 400 mm TL, 71 were 2006 year class, 220 were 2004 or older year class and 192 fish were of unknown year class. A total of 172 captures were less than the recommended stocking size of 300 mm TL. Of these, known year classes ranged from 2004 to 2006 with 84 recaptures classified as unknown year class.

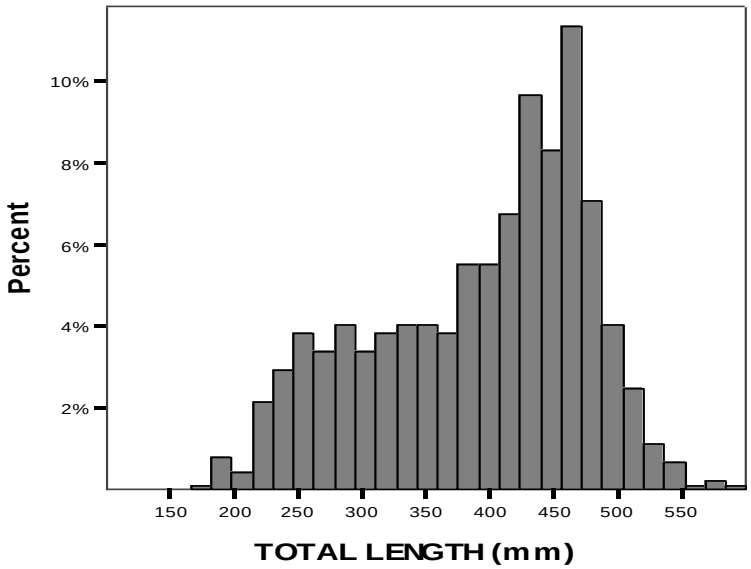

Figure 17. Length frequency histogram of razorback sucker collected during nonnative fish removal trips conducted by NMFWCO; 2007.

COLORADO PIKEMINNOW

A total of 624 Colorado pikeminnow were documented in 2007 and all were considered to be stocked fish. Colorado pikeminnow were distributed throughout the study area with the majority (77%; n = 486) of encounters occurring from RM 166.6 – 121.0. (Figure 18). Fifty-seven encounters (9%) occurred upstream of Hogback Diversion and 145 (23%) downstream of Four Corners Bridge; RM 119.2. Highest catch rates were from RM's 140.0 – 121.0 (Figure 18).

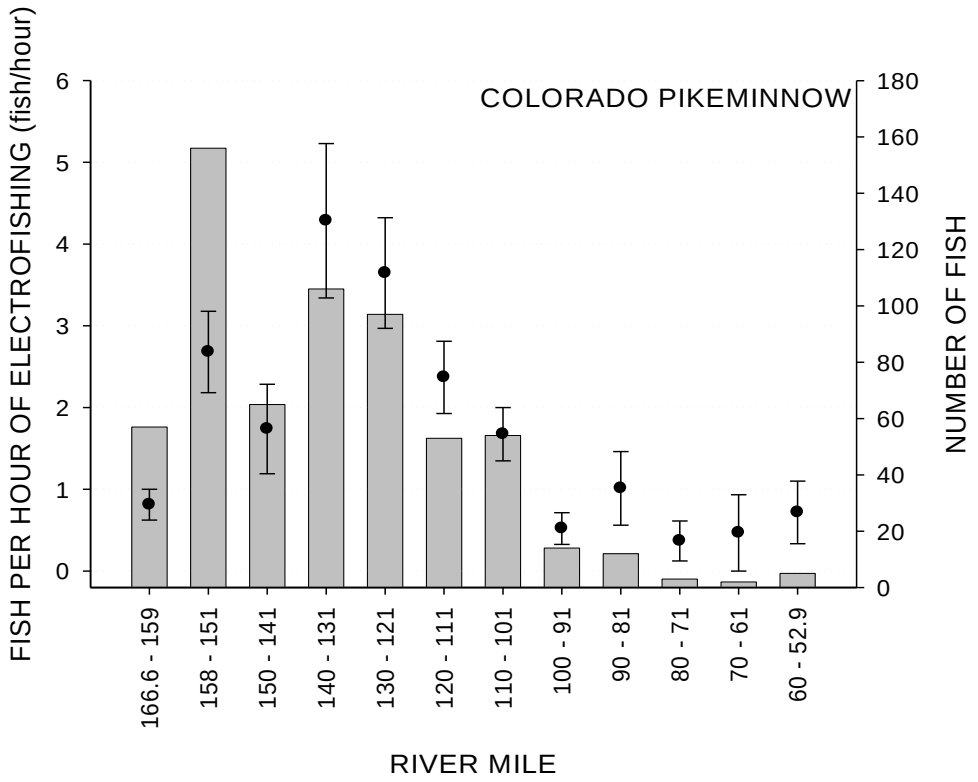

Figure 18. Longitudinal distribution of Colorado pikeminnow encounters during nonnative fish removal trips conducted by NMFWCO; 2007. Vertical bars represent number of fish and dots represent fish/hour of electrofishing. Error bars represent ± 1 SE.

Of these fish, 12 individuals were > 400 mm TL ranging in size from 411 - 709 mm TL (Table 6). These large Colorado pikeminnow were primarily captured higher in the system ranging from RM 163.7 – 110.0 with 64% (n = 9) collected upstream of RM 140.0. Five individuals were age-6 fish stocked on 03 August 2006 at RM 147.9 from Bubbling Ponds State Fish Hatchery, Arizona. These fish were collected throughout the year from RM's 157.0 – 140.0.

Based on information provided by Dale Ryden (FWS-Grand Junction), the 709 mm TL Colorado pikeminnow was stocked as an age-0 fish on 6 November 1996 by UDWR-Moab. This fish was first recaptured on 27 March 2003 by UDWR-Moab during nonnative removal efforts at RM 16.0 (530 mm TL; 1250 g). We collected this age-11 fish on 20 June 2007 at RM 119.0 in a mid-channel riffle with cobble substrate (Table 6).

Table 6. Recapture history of Colorado pikeminnow > 400 mm TL captured during nonnative removal conducted by NMFWCO; 2007. (* indicates a fish that was collected upstream of Hogback Diversion; ** represents difference in length/mass measurements from previous collection likely a result of different individuals taking measurements).

PIT tag	Recapture Date	Recapture RM	Recapture Length/Mass (mm/grams)	Comments
53180D4E7E 3D9257C69CA71	27 MAR 2003 20 JUN 2007	16.0 119.0	530 / 1250 709 / 3500	Age-11 fish stocked on 4 Nov 1996; age-0 at stocking
3D9257C6AE5F6	11 JUL 2007	110.0	597 / 1575	no tag detected at capture
522A511312 3D9257C679C9B	Unknown 05 NOV 2007	unknown 155.0	unknown 581 / 1620	no clear recapture history found
3D9257C67A20D	25 JUL 2007	163.7*	550 / 1325	no tag detected at capture
3D9257C697BE9	28 MAR 2007 07 AUG 2007 11 NOV 2007	149.0 151.0 153.0	514 / 800 539 / 960 535 / 1000**	Age-6 fish stocked on 3 Aug 2006; age-5 at stocking
3D9257C6B1570	9 JUL 2007	142.0	521 / 905	no clear recapture history found
3D9257C6977F1	02 MAY 2007	148.0	495 / 805	Age-6 fish stocked on 3 Aug 2006; age-5 at stocking
3D91BF1CD3693	12 APR 2006 05 NOV 2007	151.0 155.0	403 / 590 478 / 860	no tag detected at capture
3D9257C6BBFE3	28 MAR 2007	157.0	469 / 750	Age-6 fish stocked on 3 Aug 2006; age-5 at stocking
3D9257C697546	27 MAR 2007	151.0	433 / 510	Age-6 fish stocked on 3 Aug 2006; age-5 at stocking
3D9257C697A44	18 JUN 2007	140.0	429 / 485	Age-6 fish stocked on 3 Aug 2006; age-5 at stocking
3D91BF1D8AADF	05 OCT 2006 07 AUG 2007	82.0 157.0	355 / 320 411 / 497	no clear recapture history found

No Colorado pikeminnow > 300 mm TL were collected downstream of Montezuma Creek (Figure 19). The majority of Colorado pikeminnow collected were age-1 to age-2 fish ranging from 100 mm to 250 mm TL (Figures 19 and 20).

A total of 209 Colorado pikeminnow collected were < 150 mm TL and were considered to be fish stocked in either the fall of 2006 or 2007. Three fish < 90 mm TL were captured after the 7 November 2007 stocking and were considered age-0 fish. The remainder of fish < 150 mm TL had attained sizes that would exclude them as being from the fall 2007 stocking or were captured prior to the stocking date and were considered to be age-1 fish.

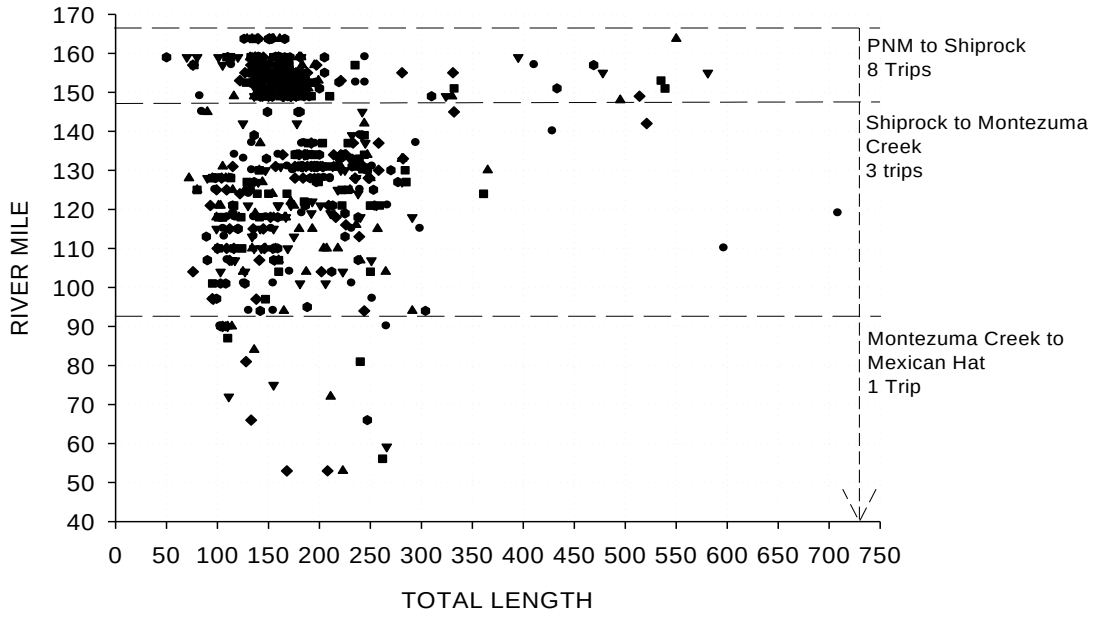

Figure 19. Longitudinal distribution of Colorado pikeminnow encounters by total length (mm) collected during nonnative fish removal trips by NMFWCO; 2007.

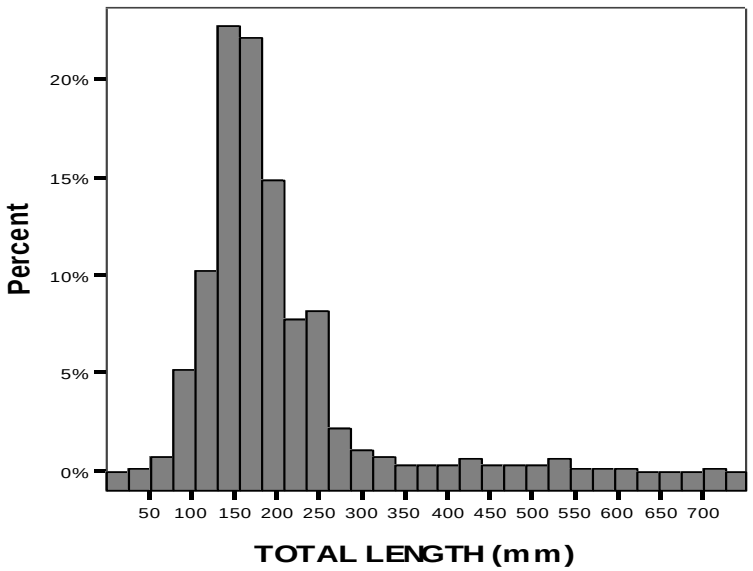

Figure 20. Length frequency histogram of Colorado pikeminnow collected during nonnative fish removal trips conducted by NMFWCO; 2007.

On 19 April 2007 1,590 age-1 Colorado pikeminnow were stocked into a side channel at RM 134.5. This stocking consisted of blocking off an area with sufficient space to acclimate fish for up to 24 hours prior to release and was conducted to address concerns regarding immediate downstream dispersal of stocked fish. A total of six nonnative removal trips were conducted post-stocking that had the opportunity to capture acclimated fish.

A total of 119 individual fish from this stocking were captured during subsequent nonnative fish removal trips. Fish were recaptured on average 85 days post-stocking (range; 60-201 days) with the majority of fish captured during the July trip from Shiprock Bridge to Montezuma Creek. Eighty five (71%) Colorado pikeminnow were recaptured within ± 5 RM's and 103 (86%) were collected ± 10 RM'of the stocking site (Figure 21). Four fish were collected on more than one occasion with each capture occurring within one RM of each other. An individual fish was recaptured 201 days post stocking at RM 149.0, 14.5 miles upstream from the stocking site. The furthest documented downstream movement was RM 101.0, 63 and 126 days post-stocking.

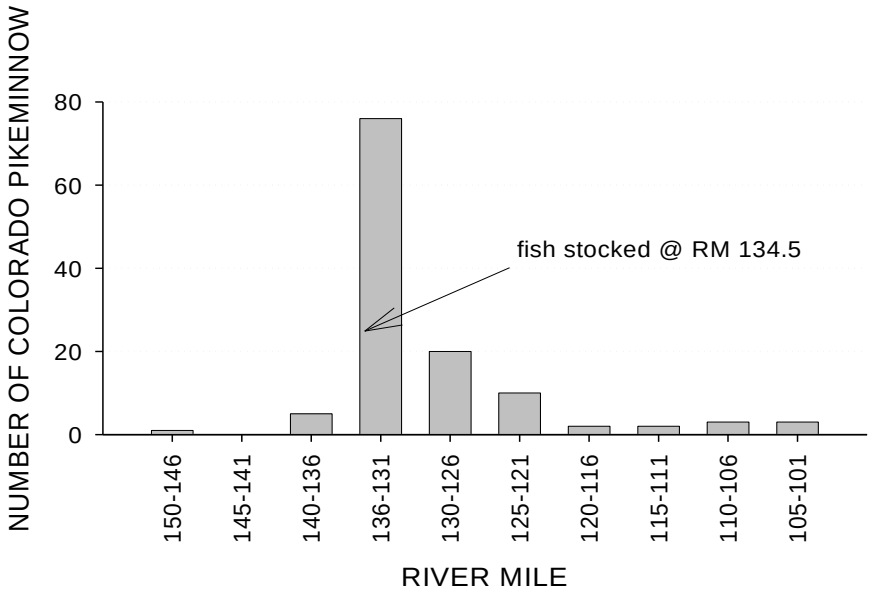

Figure 21. Longitudinal distribution of age-1 Colorado pikeminnow encounters, stocked at RM 134.5 on 19 April 2007, during nonnative fish removal trips conducted by NMFWCO; 2007.

DISCUSSION

Channel catfish abundance from PNM Weir to Hogback Diversion declined in 2007. This decline marks the first time that CPUE was significantly lower than early years of removal. These declines are likely the cumulative result of varying levels of nonnative fish removal in adjacent downstream reaches. Beginning in 2003, nonnative removal shifted efforts to include the Hogback Diversion to Shiprock Bridge Section. Channel catfish abundance was higher in this reach than beginning abundance metrics in the PNM Weir to Hogback Diversion Section. After two years of removal, channel catfish CPUE from Hogback Diversion to Shiprock Bridge was reduced to levels less than half of that at the initiation of removal.

A small scale mark-recapture study (Davis and Coleman 2004) showed that both nonnative and native fishes moved upstream of Hogback Diversion via a non-selective fish passage. By reducing overall abundance downstream of Hogback Diversion, the potential source of fish to repopulate the PNM Weir to Hogback Diversion Section has likely been reduced. Prior to 2007, seasonal fluctuations in channel catfish CPUE from PNM Weir to Hogback Diversion contributed to greater variance in catch rates and lack of significant declines in abundance (Davis and Furr 2007). It appears that a reduction in channel catfish abundance downstream of Hogback Diversion may have contributed to overall declines in abundance upstream of the diversion as well.

This step-down removal process (e.g. shifting effort based on downstream abundance) was anticipated to occur and continues downstream of Shiprock Bridge. Based on increased trends in channel catfish abundance reported on by Ryden (2007), nonnative fish removal efforts shifted effort from upstream reaches to include removal trips from Shiprock Bridge to Mexican Hat, Utah. Incorporating new information as part of the

adaptive management process and shifting effort to priority reaches is expected to result in lowered channel catfish abundance riverwide. Although removal trips have been conducted downstream to Mexican Hat since 2006, channel catfish abundance has increased over the past several years throughout these reaches (Appendix B). Based on these data, a total of four removal trips will be conducted in 2008 from Shiprock Bridge to Mexican Hat. These trips will consist of sets of two electrofishing rafts sampling in a staggered (e.g. 1-2 hours apart) manner resulting in a total of eight passes through this reach. This method is untested but is expected to remove large numbers of nonnative fishes in a relatively short period of time.

Although the mean TL of removed channel catfish has remained stable or increased in long term removal sections, the overall reduction in large (> 500 mm TL) channel catfish abundance is encouraging. Within each of these sections (PNM Weir to Hogback and Hogback to Shiprock) peaks in juvenile fish abundance was observed during some period of removal. Initial shifts towards smaller fish may be important in long term suppression and reduction of channel catfish numbers in the San Juan River by reducing overall reproductive potential and recruitment. Helms (1975) found that 1 of 10 channel catfish were sexually mature at 330 mm TL, compared to 5 of 10 at 380 mm TL. In addition, he found that channel catfish at 330 mm TL produced around 4,500 eggs/fish compared to the production of 41,500 eggs at 380 mm TL.

A reduced abundance of large channel catfish may also be important in limiting overall predatory impacts on native fishes by channel catfish. Brooks et al. (2000) found that San Juan River channel catfish < 300 mm TL consumed almost exclusively macroinvertebrates and Russian olive fruits. Piscivory occurred most frequently in fish > 450 mm TL. Documentation of predation on endangered fishes during their study was not

observed due to the relatively low numbers of endangered fishes in the San Juan River at the time of their study, but has been documented elsewhere in SJRIP work (Davis and Furr 2007 and Jackson 2005). If unchecked, as augmentation efforts continue and the numbers of rare fishes increase, documented predation by channel catfish will undoubtedly increase.

Equally as important as size reduction is the dependence of an exploited population on single year classes. Results from the upper San Juan River are similar to those Pitlo (1997) observed as evidence of overexploitation of channel catfish in the Mississippi River. It was observed that as the numbers of large fish decline, the population became highly dependent on newly recruited fish, resulting in large fluctuations in catch and dependence on the strength of individual year-classes. Dependence on individual year-classes may be occurring within intensive removal reaches with the majority of fish collected in 2007 falling in the 300-500 mm TL size class. With continued exploitation, it is anticipated that these fish will be removed prior to reproduction which may subsequently limit recruitment in future years.

Common carp were once ubiquitous in the San Juan River and during 1991-1997 SJRIP studies were found to be the fourth most abundant fish in electrofishing collections (Ryden 2000). Corresponding with the initiation of intensive removal, common carp abundance was greatly reduced to a point that common carp were uncommon in all collections across all studies.

Significant reductions in common carp abundance estimates may be a result of the "catchability" of common carp under various sampling conditions. Common carp oftentimes exhibit electrotaxis (induced movement towards the anode) or oscillotaxis (induced movement without orientation or thrashing motion) when exposed to pulsed direct current (PDC). This behavior enables netters to easily identify and net common

carp in turbid conditions. Conversely, channel catfish oftentimes exhibit tetany (electrically induced immobility with rigid muscles) when exposed to PDC and are slow in breaching the water surface (Kolz et al. 1998). This reaction makes it difficult for netters to effectively identify and capture channel catfish during turbid river conditions and may influence riverwide reductions in channel catfish abundance.

Decreased common carp abundance may possibly limit competitive interactions with native fishes and negative habitat modifications often associated with common carp (i.e. uprooting of aquatic plants causing increased turbidity, possible cause of noxious algae blooms by recycling of nutrients from silt substrates) (Cooper 1987). These decreases and the subsequent decreases in carp biomass may allow for higher utilization of resources by native fishes with limited levels of interspecific competition.

With recent flow conditions in the San Juan River lacking over bank flow, available low flow or slackwater, spawing and nursery habitats for common carp has likely been limited. The lack of available nursery habitat may have influenced recent common carp abundance trends as much as mechanical removal, and it is possible that common carp abundance may increase following the reoccurrence of overbank flows.

Intensive nonnative removal trips have contributed to the gathering of important information on rare fish distribution and abundance and may be used as a barometer to measure the success of current augmentation programs. The frequency of these trips, near stocking locations and now riverwide, provide the opportunity to gather data on stocked fish ranging from distribution, movement, and growth to determining the success of individual stockings. Within this report we attempted to summarize rare fish captures in 2007 and relate these collections to prior captures determining both temporal and spatial distribution of stocked fish.

Of interesting note was the number of razorback sucker that were collected near the stocking location at RM 158.6. Although individuals were recaptured multiple times the majority of fish collected were considered to be first time captures and were only collected once during the sampling period. In addition, razorback sucker that had been collected four or more times exhibited little movement between captures and were not captured on each trip.

The fact that these fish seem to exhibit some site fidelity near the stocking location and that individuals are not recaptured on each sampling trip raises questions regarding current densities of razorback sucker near the stocking location and our level of detection. Further analyses of these data may suggest that the Program would benefit in investigating multiple stocking locations both upstream and downstream of the current stocking location.

Tracking movement in this area could be conducted using techniques similar to a study by Kitcheyan and Montagne (2005) on Colorado pikeminnow movement in the Green River. Utilizing radio tag implanted razorback sucker with stationary telemetry loggers would determine if these fish emigrate sometime in the year only to return to the stocking location at a later date or if fish exhibit little movement suggesting that our gear type is not overly effective in collecting individuals.

Colorado pikeminnow recaptures were widely distributed in 2007. Of importance to the Program was the collection of several fish > 400 mm TL including the 709 mm TL individual collected near RM 119.0. The collection of six age-6 fish from an individual stocking in 2006 indicated that at least some of these fish have remained in the system and that this stocking may have been more successful than previously thought. In addition,

several larger Colorado pikeminnow were collected that had no clear stocking history but may have been fish stocked in the late 1990's as age-0 fish.

The majority of Colorado pikeminnow collected in 2007 were recently stocked fish ranging from 100 – 250 mm TL. The decline in catch rates for large fish was expected based on survival curves developed by Ryden (2003). The majority of Colorado pikeminnow stocked over the past several years were age-0 fish and based on these survival curves only 425 individuals would be expected to recruit to age-5 (298-453 mm). Based on our limited recaptures, Colorado pikeminnow recruitment to adulthood may be lower than expected but some survival into sub-adult to adulthood is apparently occurring.

To evaluate current population densities of listed fishes, there is a need for the Program to analyze all recapture data and relate this information to overall stocking success. These analyses will guide future augmentation decisions including numbers to be stocked, and location of stockings, and will help determine when and if population estimates on the rare fishes are needed.

SUMMARY AND CONCLUSIONS

PNM WEIR TO HOGBACK DIVERSION (RM 166.6 – 159.0)

- A total of 351 channel catfish and 141 common carp were collected in 2007.
- Channel catfish CPUE in 2007 was lower than CPUE in 2001 and 2004.
- Channel catfish mean total length (TL) in 2007 was similar to mean TL in 2001 but remained lower than values observed in 1999.
- Common carp CPUE in 2007 varied little among trip comparisons and was < 5 fish/hour.
- Common carp CPUE in 2007 was similar to CPUE in 2006 but was significantly lower than all other years ($p < 0.05$).
- Common carp were uncommon in collections.

HOGBACK DIVERSION TO SHIPROCK BRIDGE (RM 158.8 – 147.9)

- A total of 1,154 channel catfish and 142 common carp were collected in 2007.
- Channel catfish CPUE in 2007 was lower than CPUE in 2003 and 2004.
- Channel catfish CPUE was higher in this Section than in the adjacent upstream Section.
- Common carp CPUE was lower than all previous years of removal.
- Common carp were uncommon in collections.

SHIPROCK BRIDGE TO MEXICAN HAT (RM 147.9 – 52.9)

- A total of 9,214 channel catfish and 678 common carp were collected in 2007.
- Channel catfish catch rates varied between trips and was attributed to differences in sampling conditions (i.e. discharge, clarity, etc.).
- Mean TL of channel catfish decreased as sampling proceeded downstream.
- Common carp CPUE was similar between trips and was relatively low (< 6 fish/hour).
- Common carp were uncommon in collections.

RARE FISH CAPTURES

- A total of 881 razorbacks sucker and 624 Colorado pikeminnow were encountered during 2007 sampling from RM 166.6 – 52.9.
- Majority of razorback sucker encounters were documented ± 10 RM's of the stocking location (RM 158.8).
- Recommend investigation into stocking razorback sucker in multiple locations both upstream and downstream of current stocking location.
- No Colorado pikeminnow > 300 mm TL were collected downstream of Montezuma Creek, Utah.
- Short term retention of acclimated age-1 Colorado pikeminnow near the stocking location was documented with 7.5% recaptured from RM 149-101. A total of 71% (n = 85) of recaptures occurred within ± 5 RM's of the stocking site.

FUTURE OF INTENSIVE REMOVAL ON THE UPPER SAN JUAN RIVER

- Continue intensive removal efforts from RM 166.6 to 147.9.
- Expansion of removal trips to include eight electrofishing passes from Shiprock Bridge to Mexican Hat, Utah (RM 147.9 – 52.9).
- Develop measurable criteria to be used in evaluating the efficacy of non-native removal.
- Relate native fish distribution/abundance trends to non-native removal.

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Appendix A-1. Mean discharge and total count of major species collected during intensive non-native removal efforts from PNM Weir to Hogback Diversion, 2007. Species listed by the first three letters of the Genera and first three letters of Species (i.e. *Ptychocheilus lucius* = *Ptyluc*). [1] Mean discharge from USGS gauge #09368000 near Shiprock, New Mexico

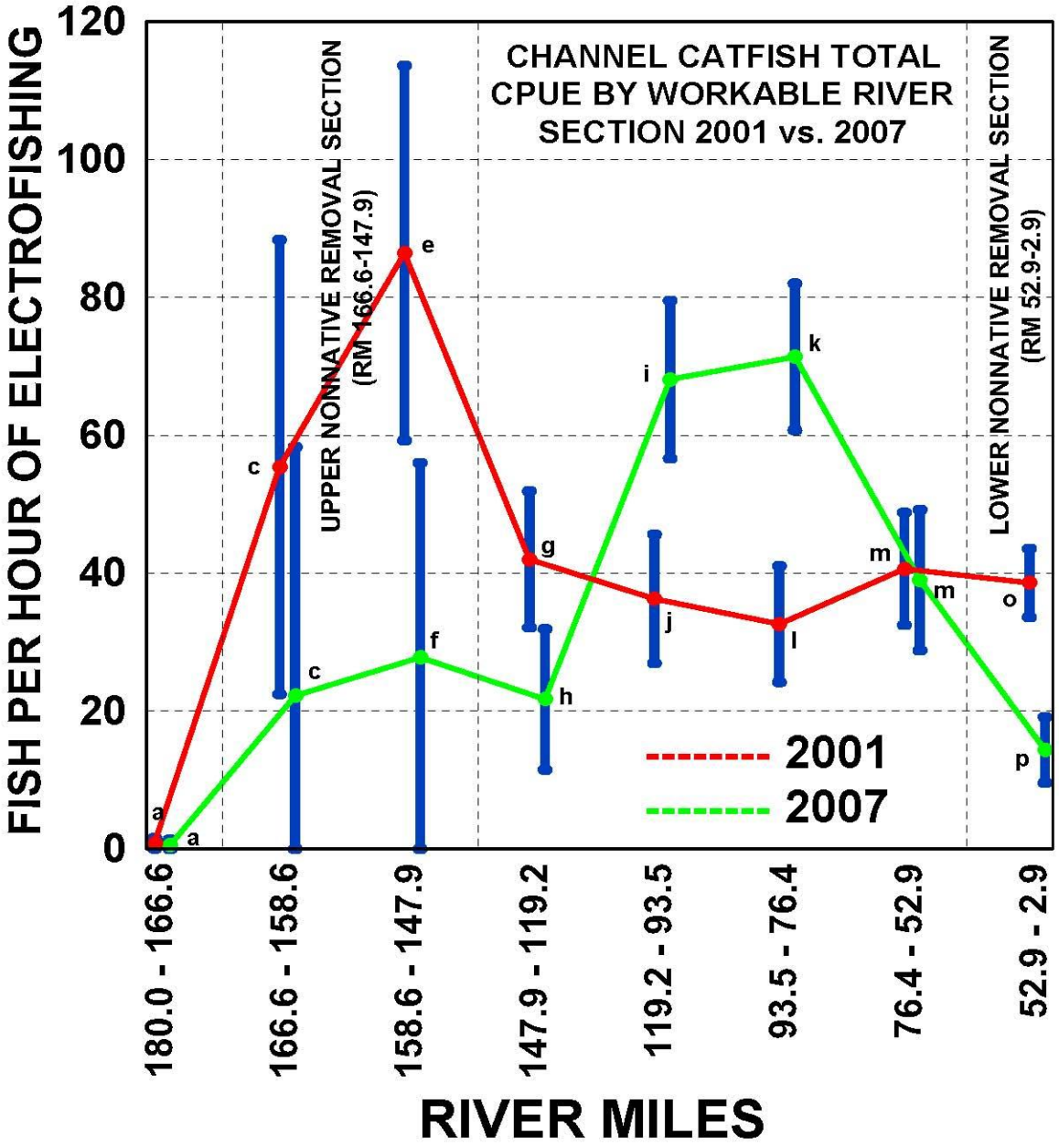
Trip	Discharge (ft^3/sec)	*Ptyluc*	*Xyrtex*	*Ictpun*	*Cypcar*	*Micsal*	*Ameiurus spp*	*Saltru*
March	1,170[1]	2	0	1	57	0	0	5
April	1,147[1]	7	25	17	36	0	0	6
July	1,225[1]	6	12	186	17	30	0	0
November	1,146[1]	42	14	147	31	0	1	7
Totals		**57**	**51**	**351**	**141**	**30**	**1**	**18**

Appendix A-2. Mean discharge and total count of major species collected during intensive non-native removal efforts from Hogback Diversion to Shiprock Bridge, 2007. [1] Mean discharge from USGS gauge #09368000 near Shiprock, New Mexico.

Trip	Discharge (ft^3/sec)	*Ptyluc*	*Xyrtex*	*Ictpun*	*Cypcar*	*Micsal*	*Ameiurus* spp	*Saltru*
March	1,417[1]	5	123	110	44	0	0	2
May	4,310[1]	3	111	25	4	0	0	1
August	4,280[1]	13	33	27	26	0	0	2
November	1,163[1]	189	215	992	68	0	3	4
Totals		**210**	**482**	**1,154**	**142**	**0**	**3**	**9**

Appendix A-3. Mean discharge and total count of major species collected during intensive non-native removal efforts from Shiprock Bridge to Mexican Hat, Utah; 2007. [1] Mean discharge from USGS gauge #09368000 near Shiprock, New Mexico. [1] Mean discharge from USGS gauge #09368000 near Shiprock, New Mexico. [2] Mean discharge from USGS gauge #09379500 near Bluff, Utah.

Trip *Shiprock to Montezuma Creek*	Discharge (ft^3/sec)	*Ptyluc*	*Xyrtex*	*Ictpun*	*Cypcar*	*Micsal*	*Ameiurus* spp	*Saltru*
June	3,410[1]	63	180	1,554	166	0	3	1
July	834[1]	153	101	3,918	263	22	13	1
August	711[1]	119	39	2,489	155	0	5	0
Totals		**335**	**320**	**7,961**	**584**	**22**	**21**	**2**
Montezuma Creek to Mexican Hat								
July	888[2]	22	28	1,253	94	22	9	0
Totals		**22**	**28**	**1,253**	**94**	**22**	**9**	**0**
Grand Total		**357**	**348**	**9,214**	**678**	**44**	**30**	**2**



Appendix B. Channel catfish total CPUE in workable sections of the San Juan River (i.e. areas between boat launches) in 2001 and 2007. The red and green sloping horizontal lines represent the mean total CPUE. The blue bars represent two standard errors. Letters by the mean CPUE values represent ANOVA comparisons within workable sections, between years. Where letters differ, total CPUE values in that river section were significantly different between years. Where letters are alike, there was no difference in total CPUE in that river section between years. Significance was determined at $p < 0.10$. **– figure provide by Dale Ryden, USFWS-Grand Junction.**